AK

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/528,262	03/17/2000	Steven P. Den Baars	585-27-009	4221

7590 11/14/2003

Koppel & Jacobs
555 St Charles Drive
Suite 107
Thousand Oaks, CA 91360

EXAMINER	
BAUMEISTER, BRADLEY W	
ART UNIT	**PAPER NUMBER**
2815	

DATE MAILED: 11/14/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/528,262	Applicant(s) Denbaars et al.
	Examiner B. William Baumeister	Art Unit 2815

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *Aug 26, 2003* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *4-7, 9, 14-16, 24-31, 33-44, and 46-55* is/are pending in the application.

4a) Of the above, claim(s) *16, 25-29, 43, 44, and 48-53* is/are withdrawn from consideration.

5)☐ Claim(s) ____ is/are allowed.

6)☒ Claim(s) *4-7, 9, 14, 15, 24, 30, 31, 33-42, 46, 47, 54, and 55* is/are rejected.

7)☐ Claim(s) ____ is/are objected to.

8)☐ Claims ____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on ____ is/are a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on ____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some* c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. ____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

a)☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1)☐ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s). 24

4)☐ Interview Summary (PTO-413) Paper No(s). ____

5)☐ Notice of Informal Patent Application (PTO-152)

6)☐ Other:

DETAILED ACTION

Claim Objections

1. Claim 37 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Independent claim 30 states in part:

> ...means for selectively causing each of said plurality of active layers to emit light alone or in combination with others of said plurality of active layers; and
> a doped substrate... absorbing at least some of said light from at least one of said plurality of active layers and re-emitting light at a different wavelength.

Dependant claim 37 recites that the "LED comprises [means such that] [either (1)] the light emitting from at least one of said plurality of active layers or [(2)] the light emitting from at least one of said plurality of active layers in combination with the light emitted from said doped substrate." Applicant confirms this interpretation:

> Claim 37 was intended to further limit claim 30 by including limitations that the active layers can selectively emit light so that the LED emits only light from the active layers or emits light from the active layers in combination with the light from the substrate. (paper #23, filed 4/25/2003, REMARKS, page 6)

The second option of claim 37-- requiring light emission from both the active layer and the substrate--is substantively of the same scope as claim 30. As such, this language does not further limit the claim. The first option--requiring light emission from only the active layer--is broader

than independent claim 30 because claim 30 also requires re-emission of secondary light from the substrate. As such, claim 37 does not further limit, but rather, broadens claim 30.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

a. Claim 39 (and the portion of the specification associated with the embodiment of FIG 2) sets forth that when a UV-blue-green, multicolor LED is formed on a substrate that is doped to emit red light (e.g., ruby), the device may be biased to effectively emit only one of red, green or blue. Restated, the ruby substrate will re-emit red light upon the absorption of UV light, but will not re-emit red light upon the absorption of blue or green light. Alternatively, claim 40 (and the portion of the specification associated with the embodiment of FIG 4) sets forth that when a blue- yellow multicolor LED is formed on a substrate that is doped to emit red light (e.g., ruby), the substrate will re-emit red light upon the absorption of yellow light. The latter disclosure indicates that the chromium impurity has a broad absorption cross-section that extends at least between the UV and yellow wavelengths (including blue and green wavelengths). As such, one skilled in the art would not apprised of how to provide a Cr-doped substrate (e.g., ruby) so that it emits red light only upon the absorption of UV light, but not upon the absorption of blue

or green wavelengths. Restated, it is unclear how the LED could ultimately emit only a single one of the green and blue wavelengths, since the substrate should also emit a second, red wavelength in response to the blue or green emission.

Claim Rejections - 35 USC § 102

3. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

4. Claims 5-7, 14, 24 and 41 are rejected under 35 U.S.C. 102(b) as being anticipated by JP '203. JP '203 discloses UV-emitting (250-410 nm), III-N double-heterojunction (e.g., [0003], i.e. single quantum well) LEDs formed on doped substrates such as sapphire that absorb the UV and re-emit various other colors including <u>at least one of</u> red, green or blue (claim 3, emphasis added), and that all three of R, G and B may be used in the same substrate [0021] and to produce a (full) color display (e.g., [0020], [0023]). The invention may further include an optional reflector for directional emission, or alternatively not include the reflector, thereby causing omnidirectional emission. Paragraph [0010] sets forth examples of potential substrate compositions, including sapphire. This paragraph also states that the substrate dopants are selected from various rare earth and transition metal elements, expressly including Cr and Ti. The substrate may be uniformly doped [0010] or alternatively in "a lot of light-emission units" (separate color centers) can be formed on the same substrate [0029]. Also, paragraph [0013]

states that the brightness of red, green and blue pixels (separate color centers) may be individually adjusted and balanced for full-color displays. A Derwent computer translation has been previously included.

a. Claim 24 is anticipated by JP '203 according to the well-established product-by-process doctrine because this is a product-by-process claim, and the recited methods of doping do not further distinguish the final structure.

b. Applicant has argued (paper #23, filed 4/21/03, REMARKS, pages 9-12) that while JP '203 teaches that the substrate may be doped throughout with a single species of impurities, it does not teach that the substrate may include a plurality of distinct dopants, all of which are doped throughout the substrate. Applicant further asserts that the reference's alternative disclosed embodiments for (full) color displays is so lacking in specifics in relation to how the arrangement of elements would be realized or how the device works, that the reference is not sufficiently enabling so as to constitute prior art.

c. As independent claim 14, and its dependent claims, are directed towards a species of the invention wherein multiple impurities are doped through the substrate, Applicant's second argument--relating to the enablement of the full-color-display embodiments--is not germane to this rejection. The only issue, in relation to the present claim set, is whether JP '203 teaches that the substrate may possess multiple distinct impurities, each doped there throughout. Contrary to Applicant's assertions, the Examiner believes that it does:

Applicants have provided a partial translation of JP '203 which they assert to be superior to that of the Derwent (machine) translation (paper #23, Remarks, page 9, first full paragraph). Applicants' translation states:

> [0010]
>
> ... The light-emission center element added to the substrate base material is an element that, when uniformly distributed throughout the base, emits light of the color red, green, or blue when [exposed to] ultraviolet emitted by semiconductor light-emitting element 3; examples are one, or two or more, [elements] selected from transition elements such as Cr, Ti, Fe, V Cu, the rare earth elements... and Y. (Underlines added by the Examiner)
>
> [0014]
>
> ... By employing as substrate 2 a sapphire substrate containing at least one element selected from the group consisting of Cr, Fe, Ti, V, Cu, and rare earth elements, it becomes possible to produce on substrate a satisfactory semiconductor light-emitting element 3 comprising a light-emitting layer of [GaN-based materials...] or the like. (Underlines added by the Examiner)

Both of these paragraphs indicate that the JP '203 reference envisioned and taught with sufficient specificity the possibility that the substrate, on which a semiconductor emitter is formed, may be doped throughout with either a single species, or alternatively, with plural species of impurities. As such, the above and following rejections, that are based on JP '203 teaching either a single impurity or plural impurities doped throughout, are maintained.

5. Claims 4-7, 14, 15, 24 and 42 are rejected under 35 U.S.C. 102(e) as being anticipated by Kaneko '901.

a. Kaneko discloses various III-N LED and LD emitters formed on doped semiconductor substrates for absorption of a primary wavelength in the range of 400-550 nm (UV-yellow) for III-N materials (col. 4, line 23; col. 5, line 7), and re-emission of a second wavelength from the doped substrate which is different/longer than that emitted from the primary LED source. The emitter may emit more than one wavelength (col. 10, lines 11-15). These wavelengths may or may not include the wavelength of the pumping light (the light that pumps the substrate activator centers) (col. 10, lines 29-36). The semiconductor substrate may be of various materials including sapphire (col. 3, lines 10-15). Various dopants or activators may be employed including Cr, Ti and Co (col. 3, line 15). The substrate may be uniformly or non-uniformly doped and a plurality of dopants can be utilized (col. 3, lines 15-20). Various wavelengths including white light can be selectively generated (col 3, lines 45-50; col. 10, lines 30-36). The invention may be employed for a variety of applications including display devices (col. 3, lines 45-50).

b. Regarding the claims setting forth that the LED emits UV or yellow, Applicant has defined UV as including 400-420 nm (specification, page 5, line 2) and yellow as including 550 nm (specification, page 8, line 4). These wavelengths are disclosed as explained above.

Claim Rejections - 35 USC § 103

6. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

7. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over JP '203 as applied to the claims above. The reference states that various conventional UV sources may be employed including LEDs and lasers. The reference further expressly discloses a double heterojunction LED having a single light emission layer (e.g., [0022]) may be employed. Regardless of whether the recitation of a double heterojunction LED is synonymous with a single quantum well (SQW) LED, it was well known to those of ordinary skill in the art at the time of the invention to form GaN-based LEDs so as to have either SQW or MQW active layers, and it would have been obvious to those persons to have employed either, depending only upon well-known design considerations such as the trade-offs in manufacturing costs and desired light output, or the specific bandgap desired and the ease of producing the specific bandgap with the particular active layer design.

8. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kaneko '901 in view of JP '203 as applied to the claims above.

a. Kaneko teaches all of the limitations as explained above except for the following: Kaneko does not anticipate claim 9 because in each of the embodiments, mirrors are employed in order to produce directional, coherent emission of the secondary light produced in the substrate, whereas claim 9 sets forth that the substrate emits light omnidirectionally.

b. As was explained above, JP '203 discloses LEDs formed on doped substrates for the emission of incoherent secondary light from the substrate. When reflectors are not employed,

the emission is omnidirectional. The light emitter is employed in display applications. It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the Kaneko invention by removing the substrate mirrors for the purpose of producing a light emitter that emits incoherent, omnidirectional light instead of coherent, directional light as taught by JP '203 depending only upon the specific lighting application desired, such as those requiring a wider viewing angle than would be afforded by devices emitting coherent, directional light.

9. Claims 9, 15 and 42 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP '203 as applied to the claims above, and further in view of Kaneko '901 as applied to the claims above. Regarding claim 9, JP '203 teaches UV primary emitters, but does not disclose yellow primary emitters. Regarding claims 15 and 42, JP '203 teaches that various rare earth or transition metal elements may be employed as the substrate dopant light emission centers. JP '203 further sets forth specific examples of Cr and Ti, but does not expressly disclose that the particular transition metal, Co, may be employed for the color (R,G,B) display.

a. Kaneko discloses various III-N LED and LD emitters formed on activator-doped semiconductor substrates for absorption of a primary wavelength in the range of 400-550 nm (UV-yellow) for III-N materials (col. 4, line 23; col. 5, line 7), and re-emission of a second wavelength from the doped substrate which is different/longer than that emitted from the primary LED source. The emitter may emit more than one wavelength (col. 10, lines 11-15). These wavelengths may or may not include the wavelength of the pumping light (the light that pumps

the substrate activator centers) (col. 10, lines 29-36). The semiconductor substrate may be of various materials including sapphire (col. 3, lines 10-15). Various dopants or activators may be employed including Cr, Ti and Co (col. 3, line 15). The substrate may be uniformly or non-uniformly doped and a plurality of dopants can be utilized (col. 3, lines 15-20). Various wavelengths including white light can be selectively generated (col 3, lines 45-50; col. 10, lines 30-36).

b. Regarding claim 9, it would have been obvious to one of ordinary skill in the art at the time of the invention to have employed within the JP '203 device, a yellow-emitting InGaN LED as taught by Kaneko, for the purpose of obtaining, e.g., an orange light, depending only upon the specific emission wavelength desired for the particular lighting application.

c. Regarding claims 15 and 42, it would have been obvious to have particularly employed Co for one of the emission centers in the JP '203 sapphire substrate as taught by Kaneko for any of various reasons such as (1) the specific cost or availability of Co vs other activators specifically recited by JP '203, or (2) the specific emission wavelength and spectral width desired for the particular lighting application.

10. Claims 30, 31, 33-40, 54 and 55 are rejected under 35 U.S.C. 103(a) as being unpatentable over either JP '203 or alternatively JP '203/Kaneko as applied to the claims above, and further in view of McIntosh '309. As was explained above, JP '203 teaches UV LEDs formed on doped substrates that cause secondary light re-emission. Kaneko discloses the LED

can be composed to emit anywhere between UV and yellow. Neither reference teaches LEDs having multiple, stacked layers capable of emitting more than one color of primary light.

a. McIntosh teaches stacked III-N LEDs having two or more quantum-well InGaN active layers that have the respective In concentrations set to emit various combinations such as blue and yellow, respectively, or B,G,R respectively. Various embodiments depict multiple contacts for selective bias of one, some, or all of the active layers to emit any desired combination of the colors. The barrier layers interposing the active layers may be p-doped (e.g., col. 3, lines 1-6). McIntosh does not teach the use of a doped substrate for secondary re-emission.

b. It would have been obvious to one of ordinary skill in the art at the time of the invention to have to have combined the teachings of JP '203 or JP '203/Kaneko with those of McIntosh so as to provide a multi-color LED that emits some plural number of the desired light wavelengths from the III-N semiconductor active layers (McIntosh), and the other one(s) of the desired wavelength(s) from the doped substrate on which the active semiconductor layers are formed (JP '203 and/or Kaneko) for the purpose of simultaneously enabling: independent color control for a full color display; reducing the lateral space requirements by not requiring separate side-by-side substrate-dopant color centers; and simplifying the manufacturing process and associated cost that would otherwise be associated with growing all three InGaN active layers and selectively etching the layers for making appropriate electrical contacts.

i. Further, it would have been specifically obvious to have employed an LED that emits UV, B and G primary light on a red-re-emitting ruby (Cr:Al203) substrate because AlN

and GaN have relatively close lattice constants while InN has a lattice constant that is not close to AlGaN. Restated, the formation of LEDs having active layers that include small amounts of In (for producing UV to green LEDs) is a relatively mature technology, but forming large In-content InGaN LEDs (for red emission) have historically presented significant problems including (1) lattice-mismatch, (2) In clustering or pooling, and (3) dissimilar requisite (lower) growth temperatures than AlGaN formation; the technology addressing these problems is not as mature. Thus, it would have been obvious to have specifically employed an LED emitting UV, B and G on a red emitting substrate for the purpose of avoiding the problems associated with growing large In content InGaN active layers.

ii. Regarding claim 40, it was known to produce white light from the two complementary colors of blue and yellow. Nichia Co. has been doing this since the mid 1990s. (See applicant's admission in the Background of the Invention, page 2). Also, McIntosh discloses using two or more layers to produce desired colors including white (e.g., FIG 5 and cols. 5 and 6). Also as was explained previously, Kaneko teaches that UV to yellow LEDs can cause secondary re-emission of red light from doped substrates. It would have been obvious to employ a blue/yellow on a red re-emitting substrate for the purpose of obtaining pink light or a white light that has a warmer hue.

11. Claim 47 is rejected under 35 U.S.C. 103(a) as being unpatentable over JP '203/McIntosh or alternatively JP '203/Kaneko/McIntosh as applied to the claims above, and further in view of Bojarczuk, Jr. et al. '185.

a. The combination of JP '203 (/Kaneko) and McIntosh teach all of the limitations of claim 30. Irrespective of whether JP '203 or Kaneko further enable the specific details of how to arrange and connect plural devices in an array, they at least suggest this general goal or desire. McIntosh further teaches how to electrically connect the various semiconductor layers for at least one, individual LED stack. These base references do not appear to further, expressly disclose any arguably conventionally-known schemes for integrating electrical circuitry with the LED on a common substrate.

b. Bojarczuk teaches a plurality of blue or UV-LEDs which are arrayed on a common light-emission substrate. See e.g., FIG 8 wherein LEDs are formed on a light emission substrate 72 and connected/integrated with circuitry on a common, Si-device-driver substrate 86. The LED is etched to form trenches that extend downward partially into the n-side layer 74 to isolate the active and p-side layers of the individual LED segments in the array. Each of the layers desired to be electrically contacted is electrically interconnected to the driver substrate: the n-side layer 74 is contacted by a common contact 84/88, and each region of the p-side layer is contacted by separate p-side contacts 82/90. UV light is emitted selectively from the three portions of the LED to be absorbed by secondary B,G,R color-emission centers 94,96,98 formed therebelow. The reference states that the embodiment of FIG 8 is a full-color display (col. 5, lines 31-33); restated,

each of the three p-side portions of the LED may be selectively biased independently. Otherwise, a full color display could not be achieved.

c. It would have been obvious to one of ordinary skill in the art at the time of the invention to have included within a color array as taught by the JP '203/Kaneko/McIntosh, a common substrate with integrated electrical circuitry as taught by Bojarczuk for the purpose of better integrating the device's components.

12. Claim 46 is rejected under 35 U.S.C. 103(a) as being unpatentable over either JP '203/McIntosh or alternatively JP '203/Kaneko/McIntosh as applied to the claims above, and further in view of Applicant's prior art admissions. As was explained above and in previous Office Actions, employing yellow down-converting phosphors was known, as was acknowledged by Applicant. It would have been obvious to one of ordinary skill in the art at the time of the invention to have employed any combination of LED active layers, down-converting phosphor-doped encapsulants and/or substrate dopants, the specific combination chosen depending only upon conventional considerations such as the respective manufacturing limitations and costs and the resultant lifetime associated with each option.

Response to Arguments

13. Applicant's arguments with respect to claims--including those arguments outlined in response to the examiner's prior office action--have been considered but are either moot in view of the new ground(s) of rejection or are not persuasive for the reasons set forth hereinabove and as follows.

a. Applicant's arguments relating to the doping of the substrate with separate color centers are moot in light of the last restriction (paper #25).

b. Applicant has argued that JP '203 teaches the emission of red, green **or** blue, but not the emission of red, green **and** blue. This is not persuasive for the reasons explained above.

c. Applicant argues that while JP '203 discusses the desire to form color arrays, it does not teach how to actually form such arrays with sufficient particularity so as to be enabling. This argument is not persuasive because the rejections do not rely upon JP '203 to teach these specific, conventional details. Rather, JP '203 was relied upon for its teachings of providing an LED with a substrate that is doped throughout with one or more impurities, and its motivation that such devices may be employed in arrays. The reference is sufficiently enabled for at least these bases.

d. In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the

time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

e. In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Conclusion

14. Applicant's amendment(s) necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

INFORMATION ON HOW TO CONTACT THE USPTO

15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to the examiner, **B. William Baumeister,** at **(703) 306-9165.** The examiner can normally be reached Monday through Friday, 8:30 a.m. to 5:00 p.m. If the Examiner is not available, the Examiner's supervisor, Mr. Tom Thomas, can be reached at (703) 308-2772. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.

BRADLEY BAUMEISTER
PRIMARY EXAMINER

B. William Baumeister

Primary Examiner, Art Unit 2815

November 12, 2003